

1. Why learn about history of science?
science is a process as well as a body of knowledge
2. Calculate the deBroglie wavelength of a 50.0 kg student running at 4.0 m/s. Compare to an electron, mass $9.11 \times 10^{-31} \text{ kg}$ moving at $2.0 \times 10^6 \text{ m/s}$. $h = 6.62 \times 10^{-34} \text{ Js}$

$$\lambda = h/p = 6.62 \times 10^{-34} \text{ Js} / 50 \text{ kg} \times 4 \text{ m/s}$$

$$= 3.3 \times 10^{-36} \text{ m}$$

$$= 6.62 \times 10^{-34} \text{ Js} / 9.11 \times 10^{-31} \text{ kg} \times 2 \times 10^6 \text{ m/s}$$

$$= 3.6 \times 10^{-10} \text{ m} - \text{can be used to resolve molecules}$$
3. The energy of orbitals in the hydrogen atom is given by

$$E = - (13.6 \text{ eV}) / n^2$$

What is the energy of the emitted photon when an electron drops from the 3rd to the first orbital?
 What is the wavelength? is it visible?

$$\Delta E = -13.6 \text{ eV} (1/n_f^2 - 1/n_i^2)$$

$$-13.6 \text{ eV} (1/(1)^2 - 1/(3)^2)$$

$$- 13.6 \text{ eV} (1 - 1/9) = -12.1 \text{ eV} \text{ of energy lost by the electron}$$

$$E = hf = hc/\lambda \quad 12.1 \text{ eV} (1.602 \times 10^{-19} \text{ J/eV}) =$$

$$12.1 \times 1.602 = 19.3842$$

$$\lambda = hc/E = 6.62 \times 10^{-34} \text{ Js} \times 3.00 \times 10^8 \text{ m/s} /$$

$$(1.94 \times 10^{-18} \text{ J}) = 1.0 \times 10^{-7} \text{ m}$$

not visible, less than 3.90×10^{-7} is outside of the

violet spectrum (Wikipedia via Jeff)

Nuclear Physics

nucleus contains protons and neutrons
the number of protons is called the atomic number, Z , and determines the element - chemical properties

The atomic mass number, A , is the number of protons+number of neutrons.

Atoms with same number of protons but different numbers of neutrons are called isotopes.

eg. uranium 235 and uranium 238 are isotopes of uranium

235 is fissionable, 238 is not, directly

uranium 235 has 92 protons and $235-92=143$ neutrons

hydrogen has 1 proton ${}^1_1\text{H}$

deuterium has 1 proton and 1 neutron (heavy water) ${}^2_1\text{H}$

tritium ${}^3_1\text{H}$ 1 proton at 2 neutrons

Tritium and Uranium 238 are radioactive
They release radiation from the nucleus.
Define types of radiation:

Gamma, γ , is electromagnetic energy from the nucleus (x-rays are from high speed electrons slowing or colliding)

high penetration - goes through lead

doesn't change the nuclear mass number or atomic number

Alpha, α , is a helium nucleus emitted from the nucleus.

low penetration - stop with paper or skin

poisonous to eat - russian spy was killed by polonium 210, an alpha source.

Beta, β , 2 types beta negative and beta positive.

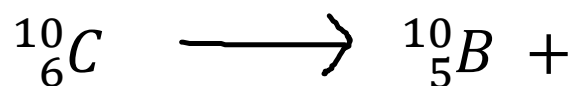
beta negative is when neutron changes into a proton (up quark changes to a down quark) and an electron and anti-matter neutrino are released.

beta positive is when a proton changes into a neutron (down quark changes into an up quark) and a positron (anti-matter electron) and neutrino are released.

neutrinos are highly unreactive particles - only interact by the weak force - not strong or electromagnetic

anti-matter is matter with same mass but

opposite quantum numbers, like charge or lepton number,
 anti-matter annihilates when it meets the matter equivalent - changes into gamma rays
 complete the decay equation:



neutrino ν
 anti-neutrino $\bar{\nu}$

p1116 Q1, 43, 45,
 next class - nuclear size, half-life, binding energy $E=mc^2$